REMARKS

Applicant thanks the Examiner for the very thorough consideration given the present application.

Claims 1-8 are now present in this application. Claim 1 is independent.

Amendments have been made to the Specification and drawings, and claims 1-8 have been amended. No new matter is added by these amendments. Reconsideration of this application, as amended, is respectfully requested.

Reasons for Entry of Amendments

At the outset, it is respectfully requested that this Amendment be entered into the Official File in view of the fact that the amendments to the claims automatically place the application in condition for allowance.

In the alternative, if the Examiner does not agree that this application is in condition for allowance, it is respectfully requested that this Amendment be entered for the purpose of appeal. This Amendment reduces the issues on appeal by placing the claims in compliance with 35 U.S.C. § 112, 1st Paragraph and 35 U.S.C. § 112, 2nd Paragraph. This Amendment was not presented at an earlier date in view of the fact that Applicant did not fully appreciate the Examiner's position until the Final Office Action was reviewed.

Objection to the Drawings

The Examiner has objected to the drawings asserting that they fail to show stopper pins in drawings 6-9 and especially Fig. 10A –10C as described in the specification. The Examiner further asserts that in Fig. 5 the stopper pins are inside of the groove, which is not covered by the substrate while in Fig. 10A-10C the groove is covered by the substrate.

In response to the Examiner's objection, the stopper pins have been deleted from Fig. 5. The stopper pin locations were provided for reference purposes and are not needed to explain the Applicant's invention. With regard to Figs. 10A-10C, the groove is not shown covered by the substrate (see Replacement Drawings submitted on March 1, 2004).

The Examiner further asserts that in Fig. 5 and Fig. 6 all parts are not labeled, especially the edge of sliding portion 42, and that the loading of the substrate at an angle of 85 degrees is not shown by a drawing.

In response to the Examiner's rejection, Fig. 5 has been amended to show the sliding portion (shaded portion), and Figs. 10A-10C. 6 have been amended to show loading of the substrate at an angle of 85 degrees.

In addition to the statements provided in seasonable traverse above, Applicant is concurrently submitting replacement sheets of drawings for the Examiner's approval, which address each of the changes made to address the

deficiencies pointed out by the Examiner. Accordingly, reconsideration and withdrawal of this objection are respectfully requested.

Specification Objection

The Examiner has objected to the specification because of several informalities.

In order to overcome this objection, Applicant has amended the specification in order to correct the deficiency pointed out by the Examiner. In addition, a Substitute Specification is being provided in order to place the application in better form. Also included is a marked-up copy of the original specification which shows the portions of the original specification which are being added and deleted. Applicant respectfully submits that the Substitute Specification includes no new matter and that the Substitute Specification includes the same changes as are indicated in the marked-up copy of the original specification showing additions and deletions.

More particularly, the phrase "generating plasma" has been deleted. Further, the confusing portions (possibly due to errors in translation) have been amended to more clearly convey that the substrate is slid onto the susceptor at an angle, and gets caught on the film-forming material. Because the loading arm is still attempting to progress the substrate forward, it will bend and sometimes break. The Applicant's specification now expresses these concepts with adequate

explanation. Reconsideration and withdrawal of this objection are respectfully requested.

Rejection Under 35 U.S.C. § 112, 1st Paragraph

Claims 1-8 stand rejected under 35 U.S.C. § 112, 1st Paragraph. This rejection is respectfully traversed.

The Examiner states that (1) "the problem caused by the friction or the relationship of the difference between the substrate and the susceptor to the damage caused is not clear" and (2) "stopper pin facilitating the stable transfer has not been described in the specification".

In order to overcome this rejection, Applicant has amended claim 1 to address the concern pointed out by the Examiner in (1), and amended the specification to address with Examiner's concerns with regard to "stopper pin facilitating the stable transfer" as stated in (2).

Applicant respectfully submits that claim 1, as amended, is fully supported by and adequately described in the written description of the invention. Accordingly, reconsideration and withdrawal of this rejection are respectfully requested.

Rejection Under 35 U.S.C. § 112, 2nd Paragraph

Claims 2 and 3 stand rejected under 35 U.S.C. § 112, 2nd Paragraph. This rejection is respectfully traversed.

The Examiner has set forth certain instances wherein the claim language is not clearly understood.

In order to overcome this rejection, Applicant has amended claim 2 to correct each of the deficiencies specifically pointed out by the Examiner. Applicant respectfully submits that claim 2, as amended, particularly point out and distinctly claim the subject matter which Applicant regards as the invention. Accordingly, reconsideration and withdrawal of this rejection are respectfully requested.

Rejection Under 35 U.S.C. § 102

Claim 1 stands rejected under 35 U.S.C. § 102(b) as being anticipated by Tepman et al. (Tepman). This rejection is respectfully traversed.

A complete discussion of the Examiner's rejection is set forth in the Office Action, and is not being repeated here.

While not conceding the appropriateness of the Examiner's rejection, but merely to advance prosecution of the instant application, Applicant respectfully submits that independent claim 1 has been amended to recite a combination of

elements in a vacuum deposition apparatus, including a portion of the susceptor providing an area used as a sliding portion on which to slide the glass substrate to a desired position; a robot arm for transferring the glass substrate onto and removing the glass substrate from the susceptor; and a groove formed in said portion of the susceptor for receiving material scraped from a surface of the susceptor by a leading edge of the glass substrate during sliding of the glass substrate on the surface of the susceptor. Applicant respectfully submits that this combination of elements as set forth in independent claim 1 is not disclosed or made obvious by the prior art of record, including Tepman.

Tepman is directed to solving a problem of unwanted deposition of species from a source such as a target, gas inlet manifold, etc. on exposed internal chamber surfaces (including the chamber walls and hardware) during a deposition process (see Tepman, Col.1, lines 20-23). In Tepman, this problem is addressed by the use of a shield. According to Tepman, shields are available which are designed to intercept such species and prevent deposition thereof on the chamber walls and hardware, but the available shields have not been successful in completely blocking unwanted deposition on these surfaces (see Tepman, Col. 1, lines 23-28).

In an attempt to address the above-described problem, Tepman provides a shield arrangement which includes a circumferential shield member

extending inwardly of the chamber and surrounding the deposition environment containing region of the chamber, and a substrate support member positionable at a retracted position to receive a substrate thereon and an extended position to position the substrate for processing in the chamber. Additionally, the support member includes a recess or groove therein (see Tepman, Col.1, lines 37-47 and Fig. 3).

Figure 3 of Tepman depicts an alternative shielded substrate support 16A which is preferred for high rate deposition, typically of relatively low stress material such as aluminum and aluminum-containing compounds and materials. Because of the possible backside deposition, the gap 50 cannot be increased sufficiently to accommodate this increased deposit thickness. Instead, a channel or groove 38 is provided in the substrate support 16A along the periphery of the substrate 14. The groove 38 allows additional build-up of deposited material (relative to a planar configuration) on the support 16 along the edge of the substrate 14 without the material sticking to the substrate and without interfering with the positioning and orientation of the substrate 14 on the substrate support member 16 (see Tepman, Col.4, lines 42-60).

In the portion of Tepman discussed above, it appears that a groove is provided to receive excess deposited material. However, the deposited material builds up as a result of a deposition process and not as a result of scraping action between the substrate and the susceptor during sliding. Rather, Tepman

seeks to solve the problem of deposited material on portions other than the susceptor. Still further, Tepman does not teach that a substrate is positioned on the susceptor by sliding. In this regard, Tepman provides as follows:

> To position a substrate 14 on the support 16, the substrate is positioned on the robot blade 34 and the blade 34 is inserted into the chamber, typically through a slit valve-controlled opening or other suitable opening (now shown) in the chamber wall, to position the substrate over the retracted (lowered) support 16 and pin array 30--30. **The pins 30--30 are raised by elevator 32 relative to the substrate support member 16 to lift the substrate 14 off the robot blade 34. The robot blade is withdrawn and the elevator 32 and pins 30--30 are lowered relative to the substrate support member 16, thereby depositing the substrate onto the spacer support pins 36--36, with the substrate being centered by the locating means 35--35**. In the illustrated embodiment, elevator 18 can be used to vary the vertical position of the support 16 and the substrate 14 relative to the processing region or the sputtering source or the gas inlet manifold, etc., to control the fabrication process.

Tepman, Col.5, lines 19-40 (emphasis added)

From the portion of Tepman quoted above, it appears plainly that sliding the substrate is not included in the process of positioning a substrate on the susceptor. Further, Tepman does not disclose that material buildup occurs on a susceptor due to friction (scraping) between the substrate and the susceptor. Therefore, Tepman fails to teach the combination of elements recited above in independent claim 1, as amended. Reconsideration and withdrawal of this art grounds of rejection are respectfully requested.

Rejections under 35 U.S.C. § 103

Claims 4 stands rejected as being unpatentable over Tepman in view of U.S. Patent No. 5,119,761 to Rempei Nataka, and claims 5-8 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tepman. These rejections are respectfully traversed.

Complete discussions of the Examiner's rejections are set forth in the Office Action, and are not being repeated here.

With regard to dependent claims 4 and 5-8, Applicant submits that claims and 5-8 depend, either directly or indirectly, from independent claim 1, which is allowable for the reasons set forth above, and therefore claims 4 and 5-8 are allowable based on their dependence from claim 1. Reconsideration and allowance thereof are respectfully requested.

Conclusion

All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider all presently outstanding rejections and that they be withdrawn. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance.

If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone Percy L. Square, Registration No. 51,084, at (703) 205-8034, in the Washington, D.C. area.

Prompt and favorable consideration of this Amendment is respectfully requested.

Applicant respectfully petitions under the provisions of 37 C.F.R. § 1.136(a) and § 1.17 for a three month extension of time in which to respond to the Examiner's Office Action. The Extension of Time Fee in the amount of $980 is included in the check which is attached hereto.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By: _____

James T. Eller, Jr.
Reg. No.: 39,538
P.O. Box 747
Falls Church, Virginia 22040-0747
Telephone: (703)205-8000

JTE:PLS:jls/ags

Attachment: Replacement Drawing Sheets
Annotated Drawing Sheets
Substitute Specification with marked-up copy

Amendments to the Drawings

The attached sheets of drawings include changes to Fig. 5 and Figs. 10A-10C. These sheets, which include Fig. 5 and Figs. 10A-10C, replace the original sheets including those same Figures.

Please amend Fig. 5 to provide shading to designate a sliding portion 42 and to delete the stopper pins 40 from the figure. Please amend Figs. 10A-10C to show a substrate being loaded at an angle of 85 degrees, and adding reference sign 30 designating the susceptor.

Attachment: Replacement Sheets
Annotated Sheets Showing Changes

FIG.5

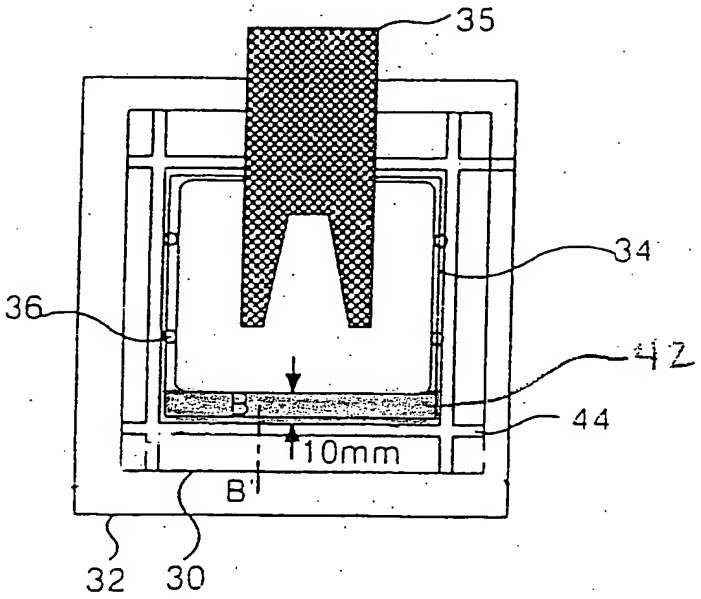
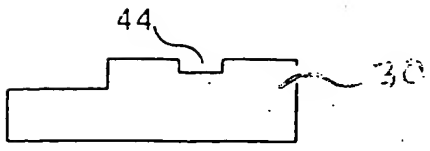


FIG.6



ANNOTATED DRAWING SHEET

FIG.10A

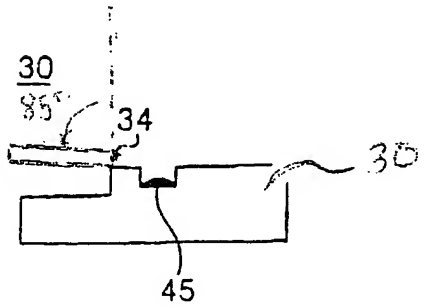


FIG.10B

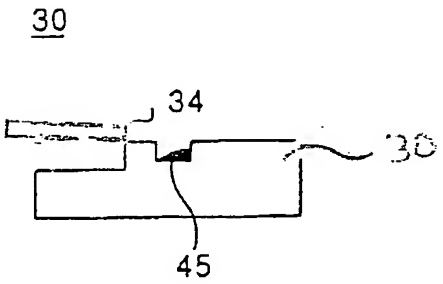
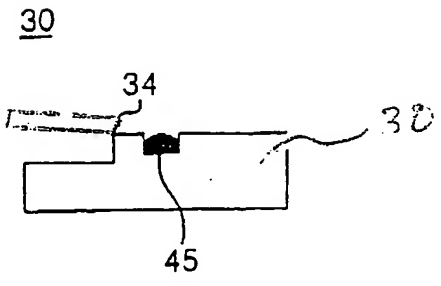


FIG.10C



VACUUM DEPOSITION APPARATUS

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] The present invention relates to a fabricating apparatus of a liquid crystal display, and more particularly to a vacuum deposition apparatus which is suitable for reducing ~~the~~ incidents of breakage of a glass ~~caused by the slide miss of the glass~~ while sliding the glass into position.

DESCRIPTION OF THE RELATED ART

[0002] Generally, a liquid crystal display (LCD) device controls the light transmissivity of liquid crystal cells in accordance with video signals for displaying a picture corresponding to the video signals on a liquid crystal panel having the liquid crystal cells arranged in a matrix pattern. To this end, the LCD device includes an active area having the liquid crystal cells arranged in an active matrix type, and driving circuits for driving the liquid crystal cells in the active area. More specifically, the LCD device includes a lower plate in which thin film transistors for switching the liquid crystal

cells, driving circuits for driving the thin film transistors and signal lines connected between the driving circuits and the thin film transistors are mounted on a lower substrate; an upper plate having color filters coated on an upper substrate in correspondence with the matrix liquid crystal cells in ~~such~~ a manner so as to be separated for each cell area by a black matrix stripe, and transparent electrodes coated on the surfaces of the color filters; a spacer provided between the upper plate and the lower plate to assure a certain cell gap; and liquid crystal disposed in a space defined between the upper and lower plates by the spacer. Such a liquid crystal display device is fabricated by preparing the upper plate and the lower plate separately, causing them to adhere to each other and then injecting the liquid crystal through a liquid crystal injection hole provided at the side portion thereof, and thereafter by coating the liquid crystal injection holes with a sealant, and then curing the sealant.

[0003] In such a fabricating method of a liquid crystal display device, an active layer included in a channel part of a thin film transistor and a protective layer protecting the transistor are generally formed by using a plasma-enhanced chemical vapor deposition (PECVD) process. Such PECVD process is implemented by a vacuum deposition apparatus as shown in Fig. 1 and 2.

[0004] Referring to Fig. 1 and 2, a conventional vacuum deposition apparatus includes a process chamber 2, and a susceptor 10 used as a lower electrode for heating a glass substrate 4 in the process chamber 2 and

generating plasma.

[0005] The glass substrate 4 is transferred onto the susceptor 10 by a robot arm 8, and returned after a deposition process.

[0006] The susceptor 10 is fixed to a support plate 18 and positioned at a certain height within the process chamber 2 by a support bar 20 that supports the support plate 18. A lift pin 6 is installed on the susceptor 10 for moving the glass substrate 4 up and down. The susceptor 10 is made to move in a vertical direction by a time belt 14 connected to the support bar 20 and a motor 12 for driving the time belt 14.

[0007] The time belt 14 driven by the motor 12 moves the support bar 20 to a desired height to cause the susceptor 10 to move to a corresponding position according to the process. In this case, the susceptor 10 is generally moved to its positions in 4 steps, that is, to the exchange position, to the load position, to the process position and to the spacing position. These positions of the susceptor 10 are determined by the driving time of the time belt 14.

[0008] The apparatus includes a location sensor 17 positioned at a side of the support bar 20 for sensing the position of the susceptor 10 and a sensed part 23 moving vertically together with the support bar 20 and positioned in a manner to face the location sensor 17.

[0009] The location sensor 17 is installed to be fixed and includes a first sensor 15 and a second sensor 16 that have different heights and thicknesses from each other.

[0010] The sensed part 23 includes a first projected part 21 adapted to selectively contact the first sensor 15 in accordance with the position of the susceptor 10 and a second projected part 22 adapted to contact the second sensor 16 at a different location in accordance with the position of the susceptor 10.

[0011] The first sensor 15 and the second sensor 16 are normally photo sensors. They generate an ON signal when they contact the first projected part 21 and the second projected part 22 of the sensed part 23. They generate an OFF signal when they do not contact the first projected part 21 and the second projected part 22 of the sensed part 23. Accordingly, the positions of the susceptor 10 can be sensed in the vacuum deposition apparatus.

[0012] ~~To describe the motion of the~~ In a vacuum deposition apparatus with such a composition, the robot arm 8 ~~transfers~~ is used to transfer the preheated glass substrate 4 from a heat chamber ~~not shown~~(not shown) to the process chamber 2. After moving to the process chamber 2, the robot arm 8 moves forward in the advancing direction as shown in Fig. 2, to have the glass substrate 4 positioned at the top of the susceptor 10. In this case, the robot arm 8 moves up to a home position ~~by~~ and the time belt 14 ~~and~~ is driven for the ~~time to be positioned so as not to interfere with~~ amount of time needed to position the susceptor 10 and the lift pin 6~~. In this way,~~ so that they do not interfere with the robot arm 8. In this way the susceptor 10 is moved up to a load position after the glass substrate 4 is positioned at the

top of the susceptor 10 by the robot arm 8, ~~the susceptor 10 is moved up to a load position by the time belt 14 that is driven for a set time,~~ so that the glass substrate 4 is supported by the lift pin 6. ~~At~~ When this ~~moment,~~ occurs the robot arm 8 is in contact with both the glass substrate 4 and the susceptor 10.

[0013] The lift pins ~~On the other hand, the first projected part 21 does not contact the first sensor 15 while the second projected part 22 of the sensed part 23, which moves up with the support bar 20, does contact with the second sensor 16 of the location sensor 17.~~

~~[0014] Thus, when the susceptor 10 is positioned in the load position, the robot arm 8 comes out of the process chamber. Then the susceptor 10 is moved up to the process position by the time belt 14 that is driven for a set period of time. At the same time, the lift pin~~ 6 supporting the glass substrate 4 ~~is inserted~~ are withdrawn into the inside of the susceptor 10 so that the glass substrate 4 is positioned on the surface of the susceptor 10. At this moment, the ON signal is generated from the first sensor 15 and the second sensor 16 of the sensed part 23 which has moved up with the support bar 20 of the susceptor 10. Subsequently, after moving up to the spacing position as the next position, the susceptor 10 applies heat and voltage to the glass substrate 4 and a desired film is deposited on the glass substrate 4 by gas and plasma.

[~~0015~~ 0014] When the deposition process is completed, the time belt 14 is driven in a reverse ~~direction that is, different from~~ sequence of the

above described sequence, and the susceptor 10 carries out the foregoing process in a reverse order so that the glass substrate 4 is conveyed to succeeding process equipment by the robot arm 8.

~~**[0016] Thus, in the process position among the motions of the conventional vacuum deposition apparatus, the vacuum deposition apparatus, as shown in Fig. 3, includes the process chamber 2, the susceptor 10 on which**~~ **0015]** At the step wherein the lift pins are withdrawn, the robot arm 8 slides the glass substrate 4 to a position wherein the leading edge of the glass substrate 4 is ~~safely placed within the process chamber 2, and the lift pin 6 for supporting~~ 2~3 mm before a stopper pin 28. The gap between the stopper pin 28 and a point at which the glass substrate 4 begins to slide into position is 5 mm.

[0016] Also, the robot arm 8 is inclined at around 85 degrees when it moves forward to place the glass substrate 4~~.~~

~~[0017] The glass substrate 4 is slid by the robot arm 8 and safely placed~~ on the surface of the susceptor 10. ~~At this moment, the susceptor 10 applies heat to~~ Due to the incline, a leading edge of the glass substrate scrapes film-forming material from the surface of the susceptor 10 and causes the material to collect on the portion of the susceptor 10 where sliding ~~4 and is used as a lower electrode for generating plasma.~~

~~[0018] The robot arm 8 transfers the pre-heated glass substrate 4 from the heat chamber (not shown) to the process chamber 2. After moving to the process chamber 2, the robot arm 8 moves forward in the advancing~~

~~direction to position~~ the glass substrate ~~4 at the top of the susceptor 10. At this moment, the lift pin 6 supporting~~ pushes it.

[0017] Fig. 4A to 4D are sectional views taken along the line A-A' of Fig. 3, and represent a process whereby the glass substrate 4 is ~~inserted into the inside of the susceptor 10 to position the glass substrate 4 at~~ interfered with by the film-forming material which collects on the surface of the susceptor 10 due to the sliding~~.~~

~~[0019] At this moment, the robot arm 8 puts the glass substrate 4 2~3 mm before a stopper pin 28 from the end~~ of the glass substrate 4~~. At this time, it become unstable upon the transfer and the conveyance of the robot arm 8 because the gap of the stopper pin 28 and a slide part where~~ on the susceptor 10 at an incline.

[0018] When the glass substrate 4 is slid onto a portion 41 of ~~safely placed, is 5 mm.~~

~~[0020] Also, the robot arm 8 is inclined at around 85 degree and moves up for safely placing the glass substrate 4 on the surface of the susceptor 10. Due to this fact, upon safely placing the glass substrate 4 on~~ the susceptor 10, it ~~becomes inclined and pressed at one side. Consequently, the friction between the surface of the susceptor 10 and the glass substrate 4 changes whereby~~ is caught by the film-forming material 11, thus halting the slide. This creates a bind ~~collects at the slide part of the susceptor 10.~~

~~[0021] Fig. 4A to 4D are sectional views taken along the line A-A'i of Fig. 3, and represent the process~~ whereby the glass substrate 4 is ~~damaged by the~~

~~film forming material which occurs on the surface of the susceptor 10 due to the frictional difference between the surface of the susceptor 10 and the glass substrate 4 safely placed on the susceptor 10 in an inclined manner.~~ broken or bent. The larger the substrate is, the more severe the bending of substrate is, and therefore the likelihood of a substrate being broken increases.

~~[0022] When the glass substrate 4 is slid into the slide part 41 of the susceptor 10, it is caught by the film forming material 11 to cause a slide to miss occur. Thereby, there occurs a problem whereby the glass substrate 4 is broken. The possibility of this occurrence increases because a bend of the substrate becomes severe due to the enlargement of the substrate.~~

~~[0023~~[0019] Also, there is difficulty in obtaining ~~the material because pyrex~~ Pyrex, a kind of glass~~,~~ is used as the material for the susceptor 10.

SUMMARY OF THE INVENTION

~~[0024~~ [0020] Accordingly, it is an object of the present invention to provide a vacuum deposition apparatus for minimizing the breakage of glass caused ~~by the slide miss~~ during sliding of the glass.

~~[0025~~ [0021] In order to achieve these and other objects of the invention, a vacuum deposition apparatus according to one aspect of the present invention includes a susceptor for applying heat to a glass substrate and generating plasma; ~~a~~ lift ~~pin~~ pins supporting said glass substrate; a

robot arm transferring said glass substrate to and returning said glass substrate from said susceptor; ~~a stopper pin which provides for the stable transfer and return of said robot arm;~~ and a groove which is formed at a ~~slide part~~ sliding portion of ~~said~~ the susceptor and into which a film-forming material provided in the deposition process is ~~inserted.~~ received.

~~[0026] In the apparatus, the~~[0022] In a preferred embodiment, a gap between the beginning of said slide ~~part~~ portion and the stopper pin is at least 3 mm~~. In the apparatus, the gap is 10 mm. In the apparatus, the~~ and as much as 10 mm. The material of the susceptor is quartz. ~~In the apparatus, the~~ The section of the groove formed in the slide ~~part~~ portion has the shape of a polygon~~. In the apparatus~~, the bottom face of the groove formed in the slide ~~part~~ portion has a curved shape~~. In the apparatus,~~ and the bottom face of the groove formed in the slide ~~part~~ portion includes an incline plane and a perpendicular plane.

[~~0027~~ 0023] Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[~~0028~~ 0024] These and other objects of the invention will be apparent from the following detailed description of the embodiments of the present invention with reference to the accompanying drawings, in which:

[~~0029~~ 0025] Figs. 1 and 2 are respectively a sectional view and a plan view representing a conventional vacuum deposition apparatus;

[~~0030~~ 0026] Fig. 3 is a plan view representing the gap between a stopper pin and a ~~safe-placed part~~ leading edge of a glass substrate shown in Fig. 2;

[~~0031~~ 0027] Figs. 4A to 4D are sectional view representing in steps that a film-forming material occurs when a glass substrate is slid ~~into~~ onto a susceptor;

[~~0032~~ 0028] Fig. 5 is a plan view representing the vacuum deposition apparatus according to the present invention;

[~~0033~~ 0029] Fig. 6 is a sectional view taken along the line B-~~B'~~ B' of Fig. 5;

[~~0034~~ 0030] Figs. 7 to 9 are sectional views of a groove formed in the slide ~~part~~ portion of a susceptor; and

[~~0035~~ 0031] Figs. 10A to 10C are sectional views showing that film-forming material collects in the groove when the glass substrate is slid ~~into a susceptor.~~ on a susceptor and a loading position of the substrate at an inclined angle.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[~~0036~~ 0032] With reference to ~~Fig.~~ Figures 5 to 10c, the preferred embodiment of the present invention is explained as follows:

[~~0037~~ 0033] Referring to Fig. 5, the vacuum deposition apparatus according to the present invention includes a susceptor 30 for applying heat to a glass substrate 34 ~~safely~~ placed within a process chamber ~~and generating plasma, a lift pin,~~ lift pins 36 supporting the glass substrate 34, a robot arm 35 for transferring the glass substrate 34 to and returning it from the susceptor 30~~, and a stopper pin 36 for the stabilization of the transfer and the return of the robot arm 35.~~.

[~~0038~~0034] The glass substrate 34 is transferred into the process chamber 32 by the robot arm 35 and ~~safely~~ placed on the surface of the susceptor 30. The susceptor 30 is used as a lower electrode for applying heat to the glass substrate 34 ~~and generating plasma~~. Quartz is used as the material of the susceptor 30 ~~for the ease of supply~~ because quartz is easy to obtain. The lift pins 36 support the glass substrate 34 which is transferred by the robot arm 35 and positioned on the susceptor 30. At least two lift pins 36 are utilized for engaging or penetrating a side of the susceptor 30.

[~~0039~~ 0035] The robot arm 35 transfers the glass substrate 34 to the process chamber 32 ~~often~~. Often the glass substrate 34 has been pre-heated in a heating chamber (not shown). After moving to the position of the process chamber 32, the robot arm 35 moves forward in an advance direction and places the glass substrate 34 on top of the susceptor 30. The

lift pins 36 supporting the glass substrate 34 are ~~inserted~~ withdrawn into the inside of the susceptor 30 ~~whereby~~ causing the glass substrate 34 ~~is~~ to be positioned on the surface of the susceptor 30.

[~~0040~~ 0036] The robot arm 35 ~~positions~~ slides the glass substrate 34 ~~at a location 2~3 mm before the stopper pin 40 from the end~~ on the surface of the susceptor 30 to a location at which the leading edge of the glass substrate 34 ~~when safely placing the glass substrate 34 on the surface of the susceptor 30.~~ is 2~3 mm before a groove 44 (discussed later).

~~[0041] At this time, to~~[0037] To make the transfer stable upon the transfer and the conveyance of the robot arm 35, a slide ~~part~~ portion of the susceptor 30, that is, the gap between the part where the glass substrate 34 is ~~safely~~ finally positioned~~,~~ and the ~~stopper pin 40~~ groove 44, is increased to be 10 mm. Thus, the ~~transfer by the robot arm 35 becomes stabilized.~~ glass substrate 34 has a longer space in which to slide.

~~[0042] Also, because~~[0038] Also, the glass substrate 34 is placed on the susceptor 30 inclined at about 85 degrees. As a result, because of the contact between the surface of the susceptor 30 ~~with an angle of 85 degree for being safely placed,~~ and the leading edge of the glass substrate 34 ~~is safely placed on the susceptor 30 inclined to one side. As a result, the friction between the surface of the susceptor 30 and the glass substrate 34 changes causing~~ during sliding, the film-forming material ~~to collect~~ is collected at the slide ~~part~~ portion 42 of ~~the~~ susceptor 30.

[~~0043~~ 0039] To minimize the occurrence of ~~a side miss of~~ interference

with the glass substrate 34 due to the film-forming material, a groove 44 is formed ~~at~~ in the slide ~~part~~ portion 42 of the susceptor 30 as shown in Figures 6 to 9.

[~~0044~~ 0040] Fig. 6 is a sectional view taken along the line B-B' illustrated in Fig. 5, showing a groove formed in the slide ~~part~~ portion 42 which, in this case, has a square sectional configuration.

[~~0045~~ 0041] Figures 7 to 9 represent various shapes of the groove 44 formed at the slide ~~part~~ portion 42. The groove 44 of Fig. 7 has ~~the~~ a shape wherein the bottom surface includes an incline plane and a perpendicular plane; ~~The~~ the groove 44 of Fig. 8 has the shape whereby the bottom surface is a curved surface; ~~The~~ and the groove 44 of Fig. 9 has a 'V' shape. Also, the groove 44 formed at the slide ~~part~~ portion 42 of the susceptor 30 may have a polygonal shape (not shown), as the shape of its section.

[~~0046~~ 0042] The groove 44 formed at the slide ~~part~~ portion 42 of the susceptor 30 makes ~~the~~ contact ~~surface~~ of the glass substrate with the film forming material 45 minimal as shown in Fig10a to 10c, when the glass substrate 34 is slid.

[~~0047~~ 0043] Figures 10a to 10c are sectional views taken along line B-~~B'1~~ B' of Fig. 5, and represent, in steps, the occurrence of the film-forming material 45 at the groove 44, which takes place by the ~~friction~~ contact between the leading edge of glass substrate 34 and the slide ~~part~~ portion 42 of the susceptor 30.

[~~0048~~ 0044] When the glass substrate 34 is slid ~~to~~ on the slide ~~part~~

portion 42 of the susceptor 30, the film-forming material 45 which accumulates by the ~~friction difference between~~ scraping of the glass substrate 34 ~~and~~ on the susceptor 30 collects in the inside of the groove 44 so that the film-forming material 45 does not ~~contact~~ interfere the glass substrate 34 during subsequent slidings.

[0045~~.~~

[~~0049~~] In this way, when the glass substrate 34 is slid ~~to~~ onto the susceptor 30, the film-forming material 45 ~~occurs~~ accumulates inside of the groove 44. Thereby, the breakage of the glass substrate 34 is prevented.

[~~0050~~ 0046] The conventional susceptor 10 uses pyrex, which is a kind of glass. On the contrary, the susceptor 30 according to the present invention uses quartz as its material, to make it easy to supply the material.

[~~0051~~ 0047] As described above, with the vacuum deposition apparatus according to the present invention, the gap is increased between the part where the glass substrate 34 is ~~safely~~ finally positioned and ~~the stopper pin 40, to make the transfer stable;~~ the groove is formed at the slide ~~part~~ portion of the susceptor, to reduce the breakage of the glass substrate due to being caught on the film-forming material and to improve the productivity and the rate of operation. Moreover, the period between periodic cleanings of the susceptor is increased to reduce the cleaning cost, and the exchange cycle is increase to decrease the production cost.

[~~0052~~ 0048] It should be understood to the ordinary skilled person in the art that the invention is not limited to the embodiments, but rather that

various changes or modifications thereof are possible without departing from the spirit of the invention. Accordingly, the scope of the invention shall be determined only by the appended claims and their equivalents.